

WHAT IS CLAIMED IS:

1. A process for characterizing a sample comprising a population of linear macromolecules of interest and a population of long chain branched macromolecules of interest, the process characterized by the steps of:

5

(a) providing a flow through separating medium (100) and a liquid eluant (101) in which the macromolecules of interest dissolve, the separating medium defining a multiplicity of flow through channels (102) which are small enough in diameter so that when the eluant containing dissolved sample macromolecules of interest is caused to flow under pressure through the channels (102) of the separating medium (100), over a certain linear velocity range, a select fraction (104) within the population of the linear macromolecules of interest will elute before a select fraction (103) of the population of the long chain branched macromolecules of interest whereby separate peak elution volumes (105) (106) of said fractions of linear macromolecules and long chain branched macromolecules of interest is established for producing differentiation of the fraction of linear macromolecules from the fraction of long chain branched macromolecules, said select fractions being of similar size, the similar size of the fractions of interest being characterized so that these fractions will co-elute in a size exclusion chromatography experiment optimized so that the fractions are separated by hydrodynamic size, and wherein the separation is conducted under temperature and solvent conditions which produce equivalent results to that obtained when the separation is conducted under isothermal and isocratic conditions;

10

15

20

(b) introducing a sample of dissolved linear macromolecules of interest and long chain branched macromolecules of interest into the liquid eluant;

25

(c) flowing the liquid eluant under pressure through the channels of the separating medium at a linear velocity that is within the range specified in step (a), whereby the sample macromolecules of interest emerge from the separating medium separated into successive elution volumes of the liquid eluant, characterized by said linear macromolecules of interest eluting (105) before said similarly sized long chain branched macromolecules of interest (106); and

30

(d) differentiating the linear macromolecules of interest from the long chain branched macromolecules of interest based on their successive elution volumes established in step (c).

2. The process of claim 1 wherein the linear macromolecules of interest are differentiated from the long chain branched macromolecules of interest by quantifying the concentration of same in each successive elution volume.

3. The process of claim 1 wherein said linear velocity range is determined on the lower end of the range by a velocity at which the sample macromolecules fail to elute from the separating medium, and at the upper end of the range by a velocity at which the long chain branched macromolecules elute in the same elution volume as the linear macromolecules of interest so that said linear macromolecules of interest cannot be differentiated from said long branched macromolecules of interest based on peak elution volume.

4. The process of claim 3 wherein the ratio of the peak elution volume of the long chain branched macromolecules of interest in the eluant to the peak elution volume of the dissolved linear macromolecules of interest in the eluant is greater than 1.

5. The process of claim 1 wherein a successive elution volume from step (c) is subjected to size exclusion chromatography to separate any macromolecules present based on hydrodynamic size.

6. The process of claim 5 wherein the macromolecules of interest eluting from the size exclusion chromatography separation medium are detected based on their concentration.

7. The process of claim 5 wherein the macromolecules of interest eluting from the size exclusion chromatography separation medium are detected by light scattering.

8. The process of claim 5 wherein the macromolecules of interest eluting from the size exclusion chromatography separation medium are detected by viscometry.

9. The process of claim 5 wherein the macromolecules of interest eluting from the size exclusion chromatography separation medium are detected based on multi-angle light scattering.
- 5 10. The process of claim 5 wherein the shape of the macromolecules of interest eluting from the size exclusion chromatography separating medium is characterized by scanning probe microscopy.
- 10 11. A polymer comprising long chain branched polymer, the polymer developed or produced using the process of any of Claim 1.
12. A polymerization catalyst for producing a polymer, the polymer comprising long chain branched polymer, the catalyst developed using the process of any of Claim 1.